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VOR TRAINING – A BASIC NAVIAGATION REQUIREMENT

The basic principle of operation of the VOR is very simple. the VOR facility transmits two signals at the same time. One signal is constant in all directions, while the other is rotated about the station. The airborne equipment receives both signals, looks (electronically) at the difference between the two signals, and interprets the result as a radial from the station.

With VOR, course information must be manually entered into the indicator. The VOR indicator below shows an aircraft heading toward, "TO," the station on the 345° radial. This aircraft is south of the station.

Figure 1:



The VOR display has four elements (**Figure 1**):

1 (A): A Rotating Course Card, calibrated from 0 to 360°, which indicates the VOR bearing chosen as the reference to fly TO or FROM. Here, the 345° radial has been set into the display. This VOR gauge also digitally displays the VOR bearing, which simplifies setting the desired navigation track.

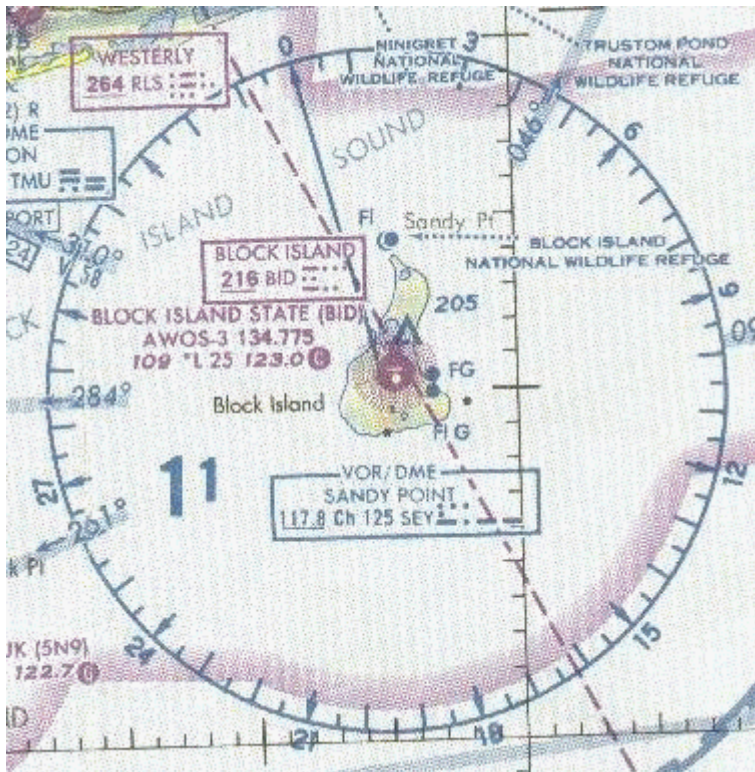
2 (B): The Omni Bearing Selector, or OBS knob, used to manually rotate the course card.

3 (C): The CDI, or Course Deviation Indicator. This needle swings left or right indicating the direction to turn to return to course. When the needle is to the left, turn left and when the needle is to the right, turn right, When centered, the aircraft is on course. Each dot in the arc under the needle represents a 2° deviation from the desired course. Here, the pilot is dead-on course.

4 (D): The TO-FROM indicator. This arrow will point up, or towards the nose of the aircraft, when flying TO the VOR station. The arrow reverses direction, points downward, when flying away FROM the VOR station. A red flag replaces these TO-FROM arrows when the VOR is beyond reception range, has not been properly tuned in, or the VOR receiver is turned off. Similarly, the flag appears if the VOR station itself is inoperative, or down for maintenance. Here, the aircraft is flying TO the station.

To grasp the VOR system you must understand that it is entirely based on radials away from the station.

Figure 2:



The arrow in **Figure 2** is located on the 0° radial points away from the center of the compass rose. this radial points to the west of true north because of the west magnetic variation. North on a VOR is Magnetic North. So, if you overflew this VOR on the 0° radial, you would be flying away from the VOR.

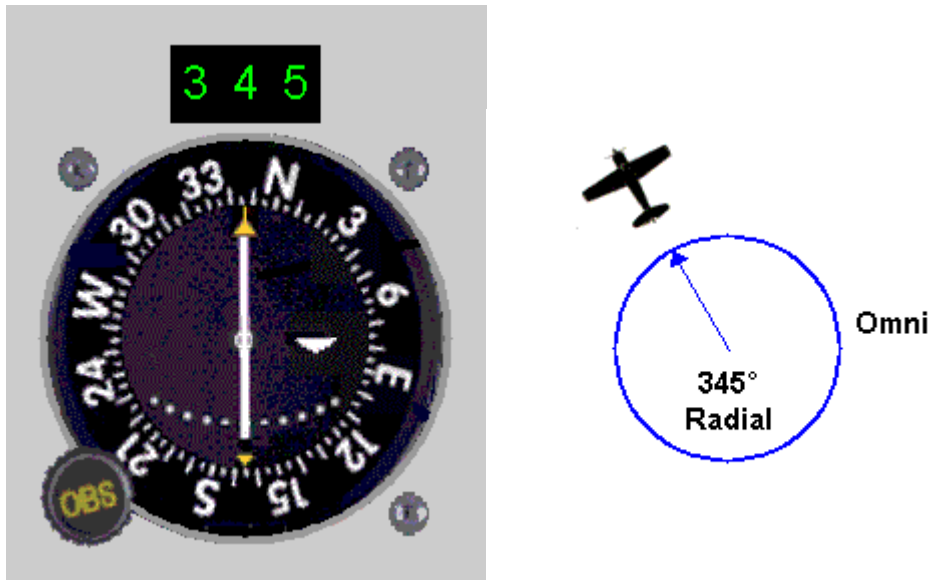
Similarly, note the arrows by the 30°, 60°, 90° marks and the rest of the way around the compass rose. They all point away from the station. Radials are always away from the station.

There is only one line on the chart for each numbered radial for a particular VOR station. Whether you are flying it outbound or inbound, or crossing it, a radial is always in the same place.

The only possible complication lies in the reciprocity of the numbers. Whenever you are proceeding outbound, your magnetic course (and heading when there is no wind) will be the same number as the

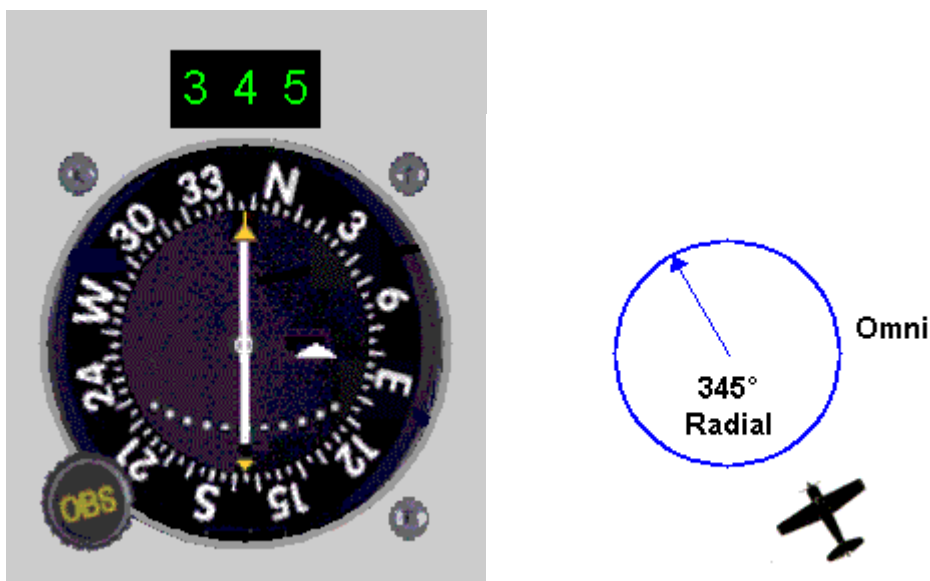
radial. Turn around and fly inbound you must mentally reverse the numbers and physically reverse the OBS setting so that your course is now the reciprocal of the radial. But the radial you are flying on hasn't changed.

Figure 3:



The above aircraft in **Figure 3** is north of the Omni station, flying on the 345° radial away FROM the station. The CDI shows the aircraft on course and the FROM flag is present, pointing down, toward the station behind.

Figure 4:



The aircraft in **Figure 4** is south of the Omni station. Its magnetic course is 345° . Walk through the steps below to understand the VOR reading.

The aircraft isn't on the 345° radial because that radial extends from the Omni to the northwest as shown by the arrow.

The aircraft is actually on the reciprocal radial, the radial pointing towards the plane. That reciprocal radial is 165° , away from the station like all radials.

If the 165° radial were set into the VOR, the FROM flag would properly show, because the aircraft is away from the Omni on that radial.

Here is the important point. If the OBS is rotated until the needle centres and the FROM flag shows, it will always show the correct radial from the Omni that the aircraft is on regardless of the aircraft heading.

To eliminate the confusion of location relative to an Omni, the magnetic course of the aircraft and the radial setting on the VOR should be the same.

Presumably the aircraft is flying in the desired course direction, so its heading will be approximately the same as the VOR setting, i.e., the magnetic course. The heading may differ slightly from the VOR because of the correction needed to correct for wind drift.

Thus, with the OBS set to 345° the CDI needle shows the aircraft on course and the TO flag is showing, pointing up, toward the station

ahead. To know whether you are flying TO or FROM an Omni, the OBS setting must be approximately the same as the aircraft heading.

Figure 5:



The illustration in **Figure 5** shows the confusion that can result, yes, that the VOR indicator can actually provide wrong information if the OBS isn't set properly.

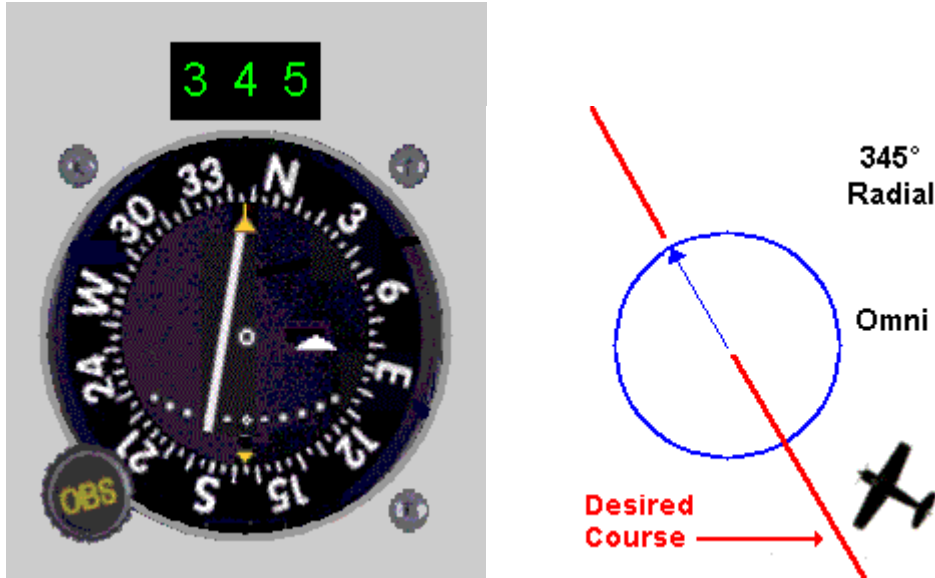
It is the same example as in Figure 1 and 2. The aircraft is south of the BEACON, on the 165° radial. It is flying northwest. Observe the COMPASS. The aircraft is heading 345° as desired. But the OBS was improperly set to 165° and the VOR is falsely informing the pilot, with a nicely centred needle, that he/she is flying away FROM the BEACON. The aircraft, of course, is flying TOWARDS the BEACON.

the TO-FROM confusion disappears if the aircraft heading and the OBS setting are approximately the same which they weren't here. Pay attention to this and you will stay out of trouble.

This sort of error usually happens when the pilot rotates the OBS, watching only for a centred needle, not also paying attention that the setting should approximate the magnetic course, or aircraft heading.

Wandering off course?

Figure 6:



The aircraft in **Figure 6** has drifted to the right of the desired course. To be "on course" the aircraft must be on the red line. Not paying attention to a crosswind, or simply letting the heading wander could do it. In any event, the VOR needle has swung to the left, indicating that the aircraft must move to the left to return to course. So a left turn is in order. a pilot always turns towards the needle to return to course, assuming that the OBS setting approximates the aircraft heading.

This aircraft is 4° off course. Each dot of the arc under the needle is a 2° deviation from the desired course. Don't confuse heading, the direction of the aircraft's nose, with course, the desired track along the ground. Only with no wind will heading and course be the same.

Continuing Education

This is a very simplistic view of VOR navigation to provide basic details for a beginner virtual flyer to start using the instrumentation. It is recommended that you read further to be completely familiar with this concept.